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SMALL FRUIT CULTURE IN CALIFORNIA

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INTRODUCTION

Small fruits, especially the brambles or fruits of the raspberry and blackberry type, are grown in nearly all parts of California. The plantings vary from the few bushes or plants cultivated for home use, to plantations in which several hundred acres may be devoted to the production of enough berries to supply both local and distant markets with fresh fruit and to allow a considerable portion of the surplus to be canned. Nearly all of the different kinds of small fruits have been found to be adapted to California soil and climatic conditions and, although some of the members of this class of fruits cannot be grown successfully on a commercial scale in the hot, dry sections of the state, with judicious handling they may often be made to thrive in the home garden. The home garden can be made to supply fresh berries of various kinds for the table throughout a long season.

The small fruit industry presents a number of problems not encountered in the production of tree fruits, many of which must be solved by more precise methods than those so largely used by deciduous fruit-growers. Berries are a soft, perishable product and must be handled accordingly; the bushes are short-lived, shallow-rooted, and subject to injury by drouth. On the other hand, if properly managed, the small fruit garden or the commercial berry plantation can be made to yield large profits, often as soon as a year or two after planting. To accomplish the best results, however, painstaking attention must be paid to all the minor details connected with the production and marketing of the crop. Broadly speaking, this class of fruits demands the personal attention of the owner or proprietor, and very often the greatest success is obtained when prac-

tically all the work can be done by the members of the immediate family.

There are a number of general factors involved in the success or failure of a berry plantation, the most important of which are the following: Accessibility to market; labor; location; water-supply; care or management of the planting. Other factors, such as insects and diseases, pruning methods and choice of varieties, while important, are more nearly under the control of the grower.

Fig. 1.—Boy from orphanage picking loganberries. The summer vacation renders this kind of labor available when needed. (Photograph by permission U. S. D. A.)

Because the crop is a very perishable one and often ripens within a comparatively short season, the small fruit plantation must have a market that may be reached quickly. The market should be either within easy driving distance of the plantation or situated on a railroad, in which case the shipping station should be near to the plantation. Jolting over rough country roads in a wagon or auto-truck during the hot portion of the day often causes berries, especially if over-ripe, to become mushy and to deteriorate very quickly. The market should be large enough to use the fruit brought to it for disposal without danger of the supply exceeding the demand, as other-

wise the price received for the product will be reduced below the point at which this fruit can be produced profitably. In case the near-by markets cannot use the crop, other outlets such as more distant markets or a cannery must be sought.

Picking berries is slow, tedious work and the result of a day's labor is often not more than a crate or two. The entire patch must be picked every day or at least every other day, at the height of the season, to insure berries of a uniform degree of ripeness. The oper-

Fig. 2.—Class at University Farm, Davis, planting strawberries on raised beds.

ation requires a great deal of stooping and reaching for the fruit near the ground, and with the brambles, the picker is often considerably scratched by the prickers on the plant during the course of a day's work. Berries are usually picked on a piece-work basis and a comparatively low price is paid for each quart or crate picked. For these reasons, the largest part of the work is done by women and children (fig. 1) or such itinerant labor as may be found during the season. Location near some fairly large city in a district where such help can be obtained is absolutely essential.

The choice of the site for the plantation is very important. A region subject to late spring frosts must be avoided. Bottom lands or swales into which cold air drains from the higher surrounding

elevations are hazardous because of the danger of the buds or flowers being frozen. The site should be chosen to allow the heavy, cold, air to drain away from the plantation to lower levels. The aspect of the plantation may influence the season of ripening to a considerable extent. With small fruits a warm exposure may cause the fruit to ripen several days or a week earlier than the same variety planted a few hundred yards away on a site which faces in another direction. Earliness is usually desirable with small fruits as it is the early fruits that command the best prices.

Small fruits belong to a shallow-rooted class of plants. This is especially true of the strawberry, which seldom sends its roots below fourteen or sixteen inches. Plants of this type, with a few exceptions, are not adapted to sending roots to a great depth for moisture, hence the available water in the soil, whether supplied by rains or by irrigation, must be carefully investigated before planting. There must be sufficient moisture in the soil during the growing season to keep the plants green and vigorous. At no time should they be allowed to wilt or show signs of drouth. Lack of moisture is shown directly by weakness of the new growth and indirectly by the subsequent smaller crops during the succeeding years. With a few notable exceptions, the small-fruit sections of California are in irrigated districts. In sections where irrigation cannot be practiced, the soil moisture must be conserved by frequent shallow cultivations.[1]

To a great extent the success of a small-fruit plantation depends upon the care given it. The operations necessary to the production of a crop of this class of fruits require more hand labor of an irksome nature than do those necessary for the tree fruits. The plants are small and set close together, which necessitates much hand hoeing in place of the horse cultivation with suffices with tree fruits. Weeds must be kept down, as they draw upon the soil moisture in the area occupied by the roots of the plants under cultivation. Operations of planting, pruning, and trellising require a great deal of hand labor because of the low-growing nature of the plants, and because of the large number of plants that are planted per acre. Tree fruits often produce fairly satisfactory crops when grown under the more or less hap-hazard methods so commonly followed by deciduous fruit growers, and the evil effects of the lack of pruning or spraying may not become apparent for a few years; but with small fruits this is not the case. A berry plantation neglected for one season, as a rule, produces a much smaller crop the following year. On the other hand,

[1] See "Irrigation Practice in Growing Small Fruits in California," by Wells A. Hutchins, Cal. Agr. Exp. Sta. Cir. no. 154.

this type of fruits responds quickly and readily to proper pruning, thorough cultivation and careful irrigation.

SOILS

The brambles, i.e., blackberries, raspberries, dewberries, and loganberries, are adapted to being grown on a wide range of soils. Success with this class of fruits depends more on the skill of the individual grower and other factors, such as site, suitable labor supply and acces-

Fig. 3.—Strawberry plant, variety, Oregon, grown under level culture system.

sibility to market, than to the choice of any particular soil. However, most of the successful plantings are found on soils ranging from sandy loam to clay loam types. As these plants are deep-rooted the depth of the soil must be given special consideration. Strawberries thrive on soils of the clay loam type, but are also found growing with considerable success on sandy loams and on the loose gravelly soils of some of the lower foothill districts. In general, the lighter types of soils are easier to handle, but the fruit is often small if not given proper cultivation and irrigation, while, on the other hand, the heavier types of soils, though harder to cultivate, produce large crops of fruit. Currants and gooseberries are two fruits generally adapted to the

heavier soils used for the growing of fruit, and often grow well on soil which is wet for a considerable portion of the year.

For all small fruits, it is desirable to have the soil well supplied with humus, for ease in cultivation and conservation of moisture. This material is best supplied by plowing under cover crops or barnyard manure.

PROPAGATION

One of the factors that have an important effect on success in growing small fruits is the ease and readiness with which a new planting may be started. New plants may be obtained from older plantations with but little trouble, or they may be purchased from a nursery at comparatively low prices. This factor is of special significance to the man of limited means just starting to grow fruit. Many of the brambles propagate naturally and abundantly of their own accord, while strawberries start annually more new plants than should be allowed to grow if best results are to be obtained from the plantation. Currants and gooseberries root readily from cuttings. The result is that new plantings may be set out, using older plantings already in existence as a source of supply, with no cost except for the labor of collecting and setting out new plants.

Blackberries and red raspberries may be propagated either by root cuttings or by suckers. These suckers, which appear wherever a root has been cut or injured, may be dug up and used as new plants, care being taken to secure a large portion of the roots. This method of securing new plants is very commonly used in this state and has proved to be satisfactory in every respect. The method of securing plants by root cuttings, which is the usual procedure in nurseries, is to dig up a number of old plants and cut the roots into short pieces, three inches or less in length. These roots are sown in rows in carefully prepared nursery soil. If not allowed to dry out and if given careful cultivation, they produce plants large enough to set out in one year from the time of making the cuttings.

Dewberries, loganberries (including the Phenomenal) and the black raspberries are usually propagated by tip layering. The method of obtaining plants in this way is to cover the end of the canes with a shovelful of earth, during the latter part of the summer. The portion of the shoot which is covered sends down roots from the nodes, and forms a plant which is ready for planting the following spring.

New plants of currants and gooseberries are usually obtained from cuttings. These fruits may also be propagated by mound layering. Cuttings are made about seven to ten inches long from matured or ripened one-year-old wood. They may be cut at any time during the dormant season, and set out immediately in rows or stored in moist sand in a cellar or other cool storage place until spring. The cuttings are planted in nursery rows with one or two buds above the surface, care being exercised to see that the soil is firmly pressed around the portion which is buried. The resulting plants are grown in the nursery for one or two

years. It is the practice in some sections of California to set these cuttings out in permanent form, instead of growing plants in the nursery row for a year.

Strawberries propagate by means of runners or offsets. During the growing season, the old established strawberry plants send out in all directions slender stems eight to fourteen or sixteen inches long. Each alternate node, if in contact with the ground, takes root and forms a new plant. The roots become established in the ground, and later, the slender stem connecting the old plant and the young, dies, leaving the new plants independent and in turn ready to send out runners. These young plants, before they have produced fruit, are the most desirable ones for planting in new plantations. The ease of gathering new

Fig. 4.—Method of growing strawberries on raised beds. Strawberries are often grown as an intercrop in orchards until the trees come into bearing.

plants should not lead to carelessness in the matter of selecting the best stock available, and certain precautions should be observed in collecting new plants from old plantations. Plants from diseased or insect-infested areas should be discarded and only clean, healthy ones chosen. Carelessness in the choice of plants often leads to the introduction of diseases and insects into sections that may previously have been clean.

PLANTING

The brambles and the bush fruits are planted so they may be easily cultivated in one or two directions. They are planted in hills or rows to conform to the growth of the plant and the nature of the

site upon which they are set. Strawberries are usually set in rows and cultivated in one direction only, relying on the use of the hand hoe for stirring the soil between the plants in the row. The planting distance is governed by the ultimate size of the plants and convenience in cultivating and picking. Whenever practicable, these fruits should be planted early in the season, preferably not later than February. A larger number of plants survive when planted early than is the case where the planting is delayed until March or April. Gooseberries and currants start to grow very early in the season and, hence, should be planted in the autumn. Strawberries are planted in the spring months or during the fall and early winter.

The preparation of the soil for the new berry plantations should be as thorough as possible. On account of the shallowness of the feeding roots of small fruits, the effort expended in preparing the soil before planting will be repaid by the vigor and thrift of the young plants. The soil should be plowed deeply in time to allow the weeds or cover crops to decompose before the plants are set out, and the soil should be as fine and friable as it is possible to make it by frequent harrowings. A mellow soil, free from lumps, enables the young plants to become established quickly, and a larger percentage live through the first year than is the case when the soil is carelessly prepared.

Blackberries should be set out during February or March in order to receive the benefit of the late rains. The plants ordinarily require but little care in planting. The long, slender roots are cut off, and the plants are set at the same depth they have been grown in the nursery. A hole is opened by a spade, the roots are spread out in a fan shape and the earth is crowded firmly around them so that all portions of the root-system come into immediate contact with the soil. The old stem is usually left as a marker or guide in cultivating before the new shoots, which usually appear from the crown, can be seen. Instead of opening each hole with a spade or shovel, a furrow may be plowed along the row and the plants placed along the landside and handled in much the same way as that just described. Blackberries of an upright-growing habit such as the Lawton are usually planted in rows six to eight feet apart with the plants four to six feet apart in the rows. If planted in hills, they are usually set six to eight feet apart each way. The trailing varieties, like the Mammoth, are planted in rows about eight feet apart and eight to sixteen feet apart in the rows. Loganberries, Phenomenal loganberries, and dewberries are trailing in habit and are spaced about the same as the Mammoth.

Raspberries.—No definite standard planting distance can be set for raspberries. The distances vary according to the variety and the district where grown. If planted in hills, the plants are from three to six feet apart each way. If planted in rows, the rows are ordinarily six to eight feet apart and the rows themselves may be a solid mass of plants or may have the separate plants from one and one-half to four or six feet apart. Ordinarily the black raspberry requires more room than do the red varieties because it is more spreading in nature.

Currants and Gooseberries.—When planted in rows, currants and gooseberries are planted two and one-half to five feet apart in the rows and the rows are five to six feet apart. In hills, the plants are set on the square system, five or six feet apart each way.

Strawberries.—Strawberries are planted according to different methods that are influenced by the irrigation practice in a given district. The necessity for frequent irrigation has led to the adoption of a number of cultural methods that will be discussed briefly in the following paragraphs. As a rule, strawberries in California are grown in rows rather than in hills, and greater acreages are grown in "raised beds" than are grown in "level culture."

Fig. 5.—Strawberries being grown as an intercrop in a young plum orchard, under level culture system.

The raised bed (fig. 2) differs from level culture in that the plants are grown on a wide row slightly raised above the intervening spaces which are used for irrigating, cultivating, and as paths for the pickers to walk upon. The sunken spaces in the raised-bed system are permanent during the continuation of the plantation, while the irrigation furrows in the level-culture system are made for each irrigation or at the beginning of each season. The width of the beds and the furrows vary greatly in the different sections. The type of soil influences the width of the bed; thus, if lateral percolation is rapid and the entire bed is moistened quickly, the width of the bed may be greater than in soils where the water soaks in slowly. The common width of the raised bed and its adjacent furrow is four or five feet; the bed itself occupying considerably more than half of this width. The beds are raised from three to six inches above the furrows and are 200 to 300 feet long.

In sections where the beds are narrow, plants are set out in a single row in the center of the bed from eight or ten inches to twenty-four inches apart, depending on the rate at which the new runners are produced and the number of plants available at the time of planting. Runners or offsets are allowed to take root in the row itself and not to spread laterally, the aim being to maintain the width of the row at ten or twelve inches. Runners spreading laterally are either cut off or moved to the center of the row. Where the beds are wider and the wide "matted row," as it is called, is desired, the plants are set out in a double row (fig. 2), the rows being eighteen to twenty-four inches apart, and four to eight inches from the edge of the bed. The plants are allowed to spread toward the edge of the bed and toward the center, forming a solid mat of plants. A variation of the matted-row system is to provide a rather narrow but deep furrow for irrigation extending for the full length of the row in the center of the bed. The paths, in the latter case, are not sunk below the beds, but maintained on the same level. When level culture (fig. 3) is practiced, the plants are set out ten to fourteen or sixteen inches apart in the row, and maintained as separate hills, or allowed to form solid rows. Irrigation water is applied by shallow furrows made as close to the rows of plants as possible, whenever needed.

The raised beds can be irrigated more conveniently than can the level-culture plantings, as the ditches are permanent and are not destroyed by cultivation. Frequently, however, water is applied without any attempt to cultivate, and the result is a hard-baked path between the rows. The level-culture system is adapted to thoroughness in cultivation and stirring of the soil between the plants.

Strawberries require greater care in planting than do most of the small fruits. Only young plants, having light-colored roots, should be used; the older plants having dark-brown roots should be discarded. The plants must not be allowed to dry out during the planting operations, but should preferably be wrapped in wet burlap or kept in pails of water. The outside whorl of leaves should be removed when the plant is set out, leaving only one or two of the small center leaves. The plant must be set firmly at the same depth at which it had been growing. If set too high, or if the soil is not sufficiently firmed, the young plants will dry out and die; and if set too low and the crown of the plant is covered with moist soil, the plant quickly rots.

CULTIVATION

Shallow cultivation should be the rule with all small fruits. The feeding roots are comparatively near to the surface and are destroyed by deep cultivation. With the brambles, a great many roots are broken by deep cultivation, and this practice results in producing a large number of suckers in the middle of the row which must be cut out with a hoe. In other cases, an entire plant is often pulled out by catching the cultivator under one of the main roots. The land should be plowed in the spring, as shallow as possible and still turn over a clean furrow and completely cover the trash or cover crop that may be on the ground. The plowing should be followed by frequent shallow stirring, preferably with a light, fine-toothed implement.

Blackberries, Loganberries, Currants, and Gooseberries may be plowed deeper toward the middle of the row and shallower when close to the plants. If the

furrows are thrown away from the row it is much easier to hoe out any weeds that may be growing in the row itself, while, on the other hand, if the furrow is thrown toward the row, these weeds are covered up, only to appear later in the season. Unevenness, due to leaving the back-furrow or dead furrow in the middle of the row is easily remedied by a few cultivations. Another plan, adopted by many growers, is to harrow or disc the plantation instead of plowing. This plan works satisfactorily if done before the cover crop has reached a size where it can only be covered by plowing. If the rows are close together, the plan of cultivating or discing to break up the soil is usually followed if the plantation is to be continued through the following year and not removed to

Fig. 6.—Wires attached to short cross-bars are used to support heavy trailing varieties of blackberries. (Photograph by permission U. S. D. A.)

make room for another crop. Clean cultivation should be practiced throughout the season until the cover crops are sown or the fall rains begin.

Strawberries are usually grown on permanent beds raised slightly above the intervening spaces (fig. 4). The method of starting spring cultivation in this case is usually to break the ground with a one-horse cultivator. If grown under the level culture system (fig. 5), one or two shallow furrows may be plowed between the rows, turning the furrows toward the middle. More often, however, the ground is broken with a single cultivator. In case the strawberries are mulched with straw or other mulching material, no cultivation is attempted. The spaces between the plants not covered by them should be hoed, to break up the crust and to keep down the weeds. Cultivations should continue throughout the season to keep the plants in thrifty condition.

PRUNING

The pruning of small fruits cannot be neglected for even a single season. Strawberries, which do not produce hard or woody stems cannot be considered as coming under this statement, their fruitfulness in a measure depending upon the number of runners allowed to be produced from the old plants; hence, they need regular attention as much as do the bush fruits. The brambles, which include all small fruits in this circular with the exception of currants, gooseberries and strawberries, produce fruit usually but once on a cane of one season's growth. There are, however, a few varieties of this class of fruits like the Himalaya and Evergreen which have perennial canes. The canes which are necessary for the bearing of the crops are produced during one season, flower and bear fruit during the next, and must then be removed. As soon as they have borne a crop of fruit their usefulness ends, and they usually die before winter. The aim of the grower in pruning should be to accomplish two things: First, to remove the old canes which are of no more value to the plant; and second, to provide a supply of new shoots for bearing fruit the following season. The care of strawberries and the pruning of currants and gooseberries are different from the general directions given above and will be discussed in the paragraphs devoted to these fruits.

Blackberries.—Blackberries are pruned in such a way that they may be tied to wire trellises (fig. 6), tied to upright stakes (fig. 7), or trained to grow upright without support of any kind. The varieties which trail, or produce long runners that naturally lie on the ground, are trained to wires stretched on posts, and the stronger upright-growing varieties are tied to stakes or pruned short so that they are able to support their own weight. The length of the canes which are left to produce the following season's crop varies considerably with the variety and with the practice found to give the best results in different sections. Strong-growing varieties like the Lawton are usually pruned back to three or four feet. Trailing varieties like the Mammoth are cut back leaving eight to fourteen or sixteen feet, depending on how far apart the plants are set in the row. It is a good practice to tip back or cut off the ends of the growing shoots during the summer as soon as they have reached the desired length. This tipping back tends to induce lateral branches to grow and thus increases the fruit-bearing area of the plant.

New canes to take the place of the old ones removed after fruiting come up as suckers around the crown of the plant. More of these suckers are produced than should be allowed to grow. For most varieties from four to seven new canes should be left to each hill and the remainder cut off close to the ground. The healthy and vigorous canes should be left and the small or inferior ones removed. This pruning should be done during the winter season.

Trailing varieties are trained to one or two wire trellises. When one wire is used, it is stretched along stakes in the row at a height of two and one-half or

three feet above the ground, and the canes are fastened to it by winding them around the wire or tying them to it (fig. 8). The new canes which grow during the season are allowed to lie on the ground under the row during the growing season. During the winter pruning the old canes are cut and pulled off the wire and the new canes are brought up and tied in their place. Sometimes two wires are used, the lower one is two to three feet from the ground and the upper wire one and one-half to two and one-half feet above the lower one. The young canes may be trained to the upper wire, and the bearing canes to the lower, or the practice may be reversed. Loganberries (including the Phenomenal variety), and dewberries are pruned and trained in the same manner as trailing

Fig. 7.—Upright varieties of blackberries are usually tied to stakes. (Photograph by permission U. S. D. A.)

blackberries. The general practice in this state has been to train these varieties on a single wire, extending the canes along the wire either in one or both directions from the crown of the plant.

Raspberries.—Both the red and the black varieties of raspberries are for the most part trained to stand alone. In some cases, when varieties are drooping in nature or a rank, heavy growth is produced, posts are set along the row and short cross-arms eighteen or twenty inches in length are nailed at a convenient distance from the ground, usually two and one-half to three and one-half feet. Wires are stretched from post to post at the end of these cross-arms. The plants are pruned so as to grow up between these wires and are supported by them and, as a rule, no additional tying is considered necessary. Blackberries may also be trained to this system (fig. 9). By means of short cross-pieces fastened to

the wires, a number of different methods of training may be devised to suit local conditions.

Raspberries produce their fruit in the same manner as do the blackberries, hence the old canes must be removed after fruiting. The plants are thinned to three to six or seven canes to the hill and cut off about three to four feet above the ground, depending upon the nature of the growth made by the plant and the training system followed. Weak-growing varieties without supports must be cut back more heavily than the more sturdy sorts. Red raspberries produce large numbers of suckers which spring up from the roots, and, unless it is desired to have a more or less solid row (fig. 10), these suckers must be grubbed out with a hoe, and the plants maintained in single units.

Fig. 8.—Loganberries tied to a single wire trellis. The young shoots are allowed to grow on the ground under the row during the first season.

Currants and Gooseberries.—These fruits must be treated in an entirely different manner from that described for the brambles. The growing habit and method of bearing fruit of these two kinds of berries must be carefully studied in order to prune them correctly. The bushes of the currant and gooseberry are more compact in form and are treated more like a tree fruit than are the brambles. New wood is produced both by the branching of existing limbs and by suckers which come up from the root. These suckers, however, come up near the crown of the plant, and not promiscuously from the roots as in the case of some of the raspberries. The larger portion of the fruit is borne from short spurs on the two and three-year-old wood, a smaller amount being produced on the four and five-year-old wood.

DURATION OF PLANTATION

Small fruits come into bearing early, reach their maximum production in from three to give years, and then begin to decline. Very few of the bush fruits remain profitable after eight or ten years, while strawberry plantations should be removed after the fourth or fifth season. The intense cultivation given this class of fruits, as a rule, quickly exhausts the humus in the soil, leaving it in a poor physical condition. In addition to the foregoing reason, the presence of one or

Fig. 9.—Trailing varieties of blackberries are trained to grow on wire trellises. (Photograph by permission U. S. D. A.)

more diseases in a field often makes it advisable to plow up and burn all of the old plants and start a new planting rather than to attempt to eradicate the trouble in the existing plantation.

Blackberries and raspberries should produce a few berries the second season after planting, reach their maximum production in from three to five years, and should be removed in from seven to ten years, according to the character of the soil and the care given the plants. Loganberries often produce fairly heavy crops the second season after planting and remain profitable a number of years. Currants and gooseberries ordinarily do not produce crops until the third year, are at their best from the third to the sixth year, and should be removed

not later than the ninth or tenth year. Strawberries normally produce their largest crops the second year, and should be removed after the fourth or fifth season.

BERRIES AS INTERCROPS

Because of the fact that berries provide a source of immediate income and occupy the soil for a limited length of time, they are used considerably as intercrops in orchards (figs. 4, 5, 8). If properly managed, no injury to the trees results, and the grower has a source of revenue until the trees come into bearing. The chief danger from using berries as an intercrop in young orchards is that the welfare of the permanent planting may be forgotten in the effort to produce one more crop after the bushes should be removed. Examples of poorly pruned, stunted trees are to be found in every section where berries have been used as intercrops. The care of the intercrop of berries should not interfere with the cultivation, pruning, spraying, or general care of the trees; hence, where it is impossible to care properly for both the berries and the trees, the trees, rather than the temporary berry plants, should be given the proper attention.

FERTILIZERS

Berries, being shallow-rooted, remove a great quantity of plant food from the surface layers of the soil, and this drain must be replenished by the addition of materials containing the elements essential to plant growth. One of the best fertilizers that can be used for this class of fruits is an annual application of well-rotted barnyard manure. Complete commercial fertilizers, or those which contain potash, phosphoric acid and nitrogen, can also be used successfully, although caution is advised in the application of any commercial product which contains a high percentage of quickly available nitrogen, because of the fact that this element often stimulates leaf production and fruit-bearing is lessened. The use of nitrogen is said to produce soft fruit that does not stand shipping. This element, however, may be added to the soil by the use of leguminous cover crops, such as vetch or bur clover, without as much danger of stimulating the vegetative vigor of the canes, with the added physical benefit of the organic matter which is incorporated in the soil at the same time.

INSECTS AND DISEASES

Small fruits are not seriously troubled by insects or diseases. The heavy annual pruning to which they are all subjected (with the

exception of the strawberry), in which the old wood and such new shoots that may show signs of disease or insect injury are removed, serves to hold these troubles in check. The comparatively frequent removal of the plantation also serves to prevent the permanent infestation of a given piece of ground. In many cases, it is cheaper to pull out the old plants and reset with healthy ones in a new location than it is to combat insects or fungous diseases by spraying or by other preventive measures.

Brambles.—The most serious disease of the brambles with which the grower must contend, is the crown-gall or root-knot. This is a bacterial disease forming

Fig. 10.—Raspberries are often grown in solid rows. The plants are either pruned to grow upright without support, or are fastened to wires as shown in the illustration. (Photograph by permission U. S. D. A.)

a warty growth on the roots and ultimately causing the death of the plants. This disease can only be held in check by planting clean stock when setting out new plantations and by removing and burning old plants which are infected in the older plantings. During some seasons the leaves of nearly all varieties of blackberries and raspberries are affected with blackberry rust, which forms reddish pustules on the under surface, or with leaf-spot, which forms small brownish spots which later drop out. The remedy for both diseases is to cut out the infected shoots or to spray with Bordeaux mixture when the disease is first noticed.

Currants and Gooseberries.—Currants and gooseberries are troubled with mildew, which forms a whitish powdery growth on the new leaves and shoots, reducing the vigor of the plantings and ultimately affecting the size of the crop. This disease is usually controlled by dusting the plants several times during the early part of the season with flowers of sulphur, or by spraying with

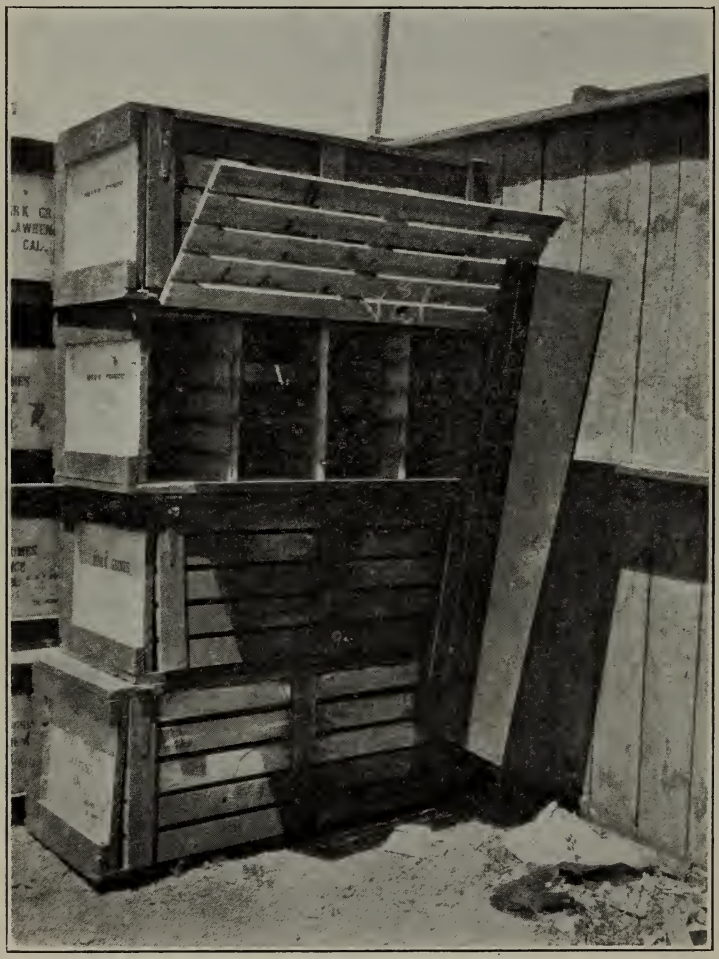

Fig. 11.—The twenty-drawer chest used in California for local shipments of small fruits. Each drawer holds two large, or six small cups. (See fig. 12.)

Bordeaux mixture as soon as the mildew appears. These two plants are also injured by the work of the currant borer. This insect works in the heart-wood of the branches or stem of the plant, which it either kills or injures to such an extent that these parts break down under the weight of the crop of fruit. The only remedy is to watch carefully for its work and remove all infested parts when pruning.

Strawberries.—The most serious disease of strawberries is leaf-spot. This disease causes irregular spots on the leaves and, in serious cases, the crop is greatly reduced. The plants should be sprayed with Bordeaux mixture before or just after blossoming. In badly infected areas, the plants should be mowed close to the ground and the leaves burned.

Information regarding the insect pests or diseases will be furnished by the California Experiment Station upon request. A description of the trouble and a sample of the affected leaves or branches should be sent for identification.

Fig. 12.—Drawers from fruit chest showing the two sizes of cups generally used. (Photograph by permission U. S. D. A.)

HARVESTING

Berries are the most perishable fruits that are now being grown on a commercial scale, and cannot be handled in the same way as even the tender kinds of tree fruits. The length of time between reaching a stage of maturity when they are of highest quality for table use and when they begin to deteriorate is very short. The perishable nature of this class of fruit necessitates extremely careful handling, prompt shipping, and immediate consumption. No class of fruit has better flavor or quality when at the proper stage of ripeness, or decays more quickly when not properly handled.

Brambles.—The brambles should be picked often during the height of the season. During the early part of the picking season, the patch should be picked

every three or four days, but when the berries begin to ripen faster, the entire patch should be picked each day. Berries should be picked directly into the box or cup in which they are sold, and should not be handled by regrading or sorting. The marketable grades should be picked directly into the market packages, and the soft fruit either picked into a separate receptacle or dropped on the ground. Berries crushed in picking should not be mixed with the sound fruit. The berries should not be left standing in the sun, but should be placed in the shade, under a tree, or in the packing house. No berries should be picked when wet from rain or fog. All fruit should be taken to market or shipping station as soon after packing as possible. The use to which the berries are to be put determines the

Fig. 13.—Type of crate used for shipping berries. (Photograph by permission U. S. D. A.)

exact stage of ripeness at which they should be picked. Generally speaking, raspberries may be used for local or near-by markets when they separate from the "core" without crumpling or falling apart. For long-distance shipments only the firmer berries should be used, while the softer grades are utilized for canning. Blackberries, loganberries and other brambles in which the berry does not separate from the core or receptacle, for long-distance shipments must be picked when hard and firm, though well colored. Fruit which is somewhat softer, although not mushy, may be used for local markets. The common package for marketing this class of fruits locally is the twenty-drawer chest (fig. 11), each drawer of which holds two large or six small cups (fig. 12). Crates holding twenty-four one-quart boxes (fig. 13) are universally used for long-distance shipments and also, to a limited extent, in shipping to local markets.

Currants and Gooseberries.—Currants are usually harvested in two pickings. There is no danger of the fruit becoming soft under ordinary conditions, but during a period of hot weather injury from scalding often results. The danger of loss from this cause is reduced by making two pickings. The fruit is in right condition for picking when all the berries on the cluster are red. The cluster should be picked whole, and the berries not separated from the stem, as when the berries are picked from the cluster, the entire package is moistened with the juice which escapes and decay quickly follows. Gooseberries are sometimes picked by holding a portion of the bush in a gloved hand and picking with the bare hand. On a large scale they are picked by stripping the leaves and fruit into a shallow box and then removing the leaves by running the entire picking through a fanning mill which blows out the leaves and pieces of branches. As the fruit is picked while still hard and green, no injury results from this method of handling.

Strawberries.—Strawberries are picked every day or two throughout the season. For long-distance shipment the berries are picked showing considerable green or white color, and while still very hard in texture. For near-by markets, the fruit must be well-colored but still firm and not mushy. Berries must be picked with the calyx attached and preferably a short portion of the stem. Strawberries may be "faced" or turned with the stem down and the attractive side uppermost, but the quality and size of the fruit must be the same throughout the package. They are marketed in the twenty-drawer chest (fig. 11) or in crates containing twenty-four one-pint boxes.

VARIETIES

The following is a brief description of the principal varieties of the different small fruits grown in California. It is not intended to be a complete reference to all varieties of small fruits, but simply a short discussion of the varieties now being grown or those considered worthy of trial.

Blackberries

Lawton.—Bush sturdy; erect; strong grower; heavy producer. Fruit is large, black, sweet and of excellent quality. Mid-season. The standard blackberry in California.

Kittatinny.—Strong grower; hardy; productive. Fruit is large, glossy black, sweet and of good quality. Mid-season to late. Popular.

Early Harvest.—Strong upright grower; hardy; good producer. Fruit is medium to small, sweet and of good quality. Season is early and fruit ripens over long period. Susceptible to leaf rust.

Crandall.—Vigorous; hardy; productive; ripens fruit over long season. Fruit is large, firm and sweet. Season early. Very popular especially in southern part of state.

Wilson Junior.—Hardy; upright grower and productive. Fruit is large and black. Season early.

Evergreen (Oregon Evergreen).—Bush vigorous; strong growing; drooping; perennial. Fruit is large, firm, sweet and of good quality. Season, late to very late. Worthy of trial.

Mammoth.—Extremely vigorous; fairly hardy; rapid grower and a heavy producer. Canes are semi-trailing or trailing. Fruit is very large, long in shape, black, sweet, and soft when fully ripe. Very popular in California, ripening early to mid-season, usually between the loganberry and the Lawton.

Hybrids

Loganberry.—Canes are vigorous, hardy and exceptionally productive; trailing in habit, covered with a large number of rather small spines. Fruit is long, large, dark-red in color, sub-acid in flavor and good in quality. Excellent for shipping or canning. Season early. Grown in nearly all berry sections of California.

Phenomenal.—A variety of loganberry very similar to the original variety. Held by some growers to be indistinguishable from the original loganberry. Vines are strong, vigorous and productive. Fruit is large, long, red in color, sub-acid in flavor, larger than loganberry but softer in texture. Generally given same culture as loganberry.

Himalaya.—Bush extremely vigorous; very spiny; trailing or semi-trailing; perennial and reported a heavy producer. Fruit is roundish in form, medium size, and juicy. Season from June to late fall.

Dewberries

Gardena.—Vigorous grower; heavy producer. Fruit is large, glossy black, firm, sweet and delicious. Season early. Popular in southern part of state.

Lucretia.—Hardy and productive; berries are large, sweet, black in color and soft; said to ripen shortly after the Gardena. A general purpose variety.

Red Raspberries

Cuthbert.—Hardy; vigorous grower, with heavy foliage which protects fruit from sunburn. A heavy and regular bearer. Fruit is deep red in color, large, conical, firm, separates readily from core and is a good shipper. One of the most popular mid-season varieties in California.

Hansel.—Vigorous grower. Fruit is medium to large, and bright red. Season early.

Superlative.—New variety. Fruit is medium to large, excellent flavor, and ripens over a long season.

Antwerp.—An old variety, not generally planted in this state. Plants not vigorous except under favorable soil and climatic conditions. Fruit is dark red, firm, of excellent quality and a good shipper.

Black Raspberries

Gregg.—Plants are strong, hardy and productive. Berries are medium in size, firm and sweet. Mid-season. The standard variety of black-caps for home or commercial planting.

Kansas.—Strong; vigorous grower; hardy and productive. Fruit is early in season, medium size, black, firm and of good quality.

Souhegan.—Fruit is large, firm and sweet. Season early.

Currants

Cherry.—Bush is fairly vigorous, hardy, medium in size and a good bearer. Fruit is large, bright red and borne on rather stout, well-filled bunches. The leading variety in the central part of the state. Somewhat subject to attacks by mildew and cane borers.

Fay.—A new variety, said to bear more abundantly than the cherry. Fruit is said to be less acid than the former.

Perfection.—A new variety, grown very successfully in eastern currant districts. Bush is vigorous, healthy, strong-growing and very productive. Berries are large, bright red, borne on long well-filled bunches, flavor acid. Worthy of trial in this state.

Pomona.—Bush is vigorous, hardy and a good producer. Berries are medium in size, red and hang well after ripening.

White Grape.—One of the white varieties. Manner of growth and bearing same as that of red currants. Does not yield as heavily as red varieties and does not have the brisk acid flavor of the former. Grown principally for home use.

Gooseberries

Downing.—Bushes are vigorous, sturdy and productive. Berries are medium to large, oval in shape, smooth, yellow sprinkled with red dots when ripe. Flavor sweet and pleasant when fully ripe. A good market variety.

Houghton.—One of the oldest varieties. Bushes are strong-growing, long-lived and productive. Berries are small, roundish, dull red when fully ripe, skin smooth and thin. Ripens in advance of the Downing. Chief disadvantage of this variety is the small size of the berry. Resistant to mildew.

Champion.—Bush is a strong grower and a prolific bearer. Berries are medium size, smooth, roundish-oval, sweet when fully mature. Resistant to mildew.

Industry.—One of the English varieties. Bush is vigorous, upright, and a good bearer. Berries large and dark red when ripe. Subject to mildew.

Berkeley.—Bush is fairly vigorous grower and good bearer. Berries are very large and ripen early. An English variety and subject to mildew.

Strawberries

Marshall.—Plant is vigorous, healthy and a good producer of new plants. Flower, perfect. Fruit is medium to large, dark red, flesh somewhat lighter in color, firm, roundish-conic in shape. Grown in Fresno district, upper interior valleys and in Watsonville district. Identical with Banner.

Jessie.—Average in size and vigor; fairly good plant producer; good bearer. Flower, perfect. Fruit is medium to below in size, roundish conic, dark red, flesh, red and firm. Grown in Fresno district and upper interior valleys.

Gold Dollar.—Medium in size and vigor; erect; good plant maker. Flower perfect. Fruit, rather elongated conic, dark red; flesh, somewhat lighter, firm. Grown almost exclusively in the Florin and Newcastle section. Ripens early and produces over a long period.

Malinda.—Plant is inclined to be small; fair plant producer. Flower, perfect. Fruit is small in size, conic in shape; flesh is a dark red, firm and has a firm core. Grown, with others, in Pajaro Valley.

Oregon.—Plant is medium in size, vigorous, erect, good plant maker and a heavy producer. Flower, perfect. Fruit, medium to large, broad conic, dark red; flesh, medium red and inclined to be soft. Popular in Pajaro and Santa Clara valleys, and in the Sebastopol section.

Klondike.—Vigorous and fairly good plant maker; fair producer. Flower perfect. Fruit is of fair size, roundish, dark red, firm and a good shipper. Largely planted in region around Los Angeles.

Nick Ohmer.—Medium in size and vigor; is a fair producer and plant maker. Flower, perfect. Fruit is medium in size, roundish-conic, medium red and soft. Grown in districts adjacent to San Francisco.

Brandywine.—Medium in size, compact, a fair producer and plant maker. Flower, perfect. Fruit conic in shape, light to medium red and firm and a good shipping variety. Season is medium to late. Largely grown in Los Angeles section.

Excelsior.—Vigorous; a medium producer and a good plant producer. Flower, perfect. Fruit is medium in size, conic, medium red and firm. Grown in Los Angeles section. Sharply acid in flavor but very early.

Arizona.—A good plant maker; fairly vigorous; a fair producer and drouth resistant. Flower, perfect. Fruit is medium in size, conic, compressed, dark red and firm.

Ettersburg Varieties.—Ettersburg nos. 80, 89, and 121, as grown at the University Farm at Davis, have proved themselves to be extremely vigorous, upright or erect, good plant makers. Have not been tried sufficiently for making any recommendations.